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Forest Insect and Disease Conditions in the Southwestern Region, 2002

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Cover photo: Ponderosa pine mortality caused by the Arizona five-spined Ips (*Ips lecontei*) in the Horsethief Basin Recreation Area, Prescott National Forest (August 2002).

Introduction

Insects and diseases act as both indicators and regulators of the condition or "health" of southwestern forests. This report summarizes the current known status of insects and diseases in the forests of Arizona and New Mexico. Most of the insect information is based on annual aerial detection surveys. Most of the disease information is based on ground observations and surveys. Bark beetles and defoliating insects cause sudden, visually dramatic damage that is readily seen from the air, while most pathogens cause gradual, insidious damage that is not.

Bark beetles—the primary conifer killers in the region—tend to be host specific. Furthermore, except for ponderosa pine, most conifers are killed by a single species of bark beetle. A group of recent Douglas-fir "faders," for example, is most often a result of attack by the Douglas-fir bark beetle, *Dendroctonus pseudotsugae*. In contrast, ponderosa pines are attacked and killed by several different bark beetles. Thus, ground surveys may be needed to confirm the species responsible for ponderosa pine mortality seen from the air. Where ground checking is not conducted, assignment of causal species is based on previous history/experience for a given location.

This report also includes a record of technical assistance provided by Arizona and New Mexico zone personnel and brief descriptions of several special activities conducted in 2002. Much of the information for State and private lands was provided through our State Cooperative Forest Health Program by Tom DeGomez and Doug Rautenkranz, University of Arizona Cooperative Extension, and Robert J. Cain, Extension Forest Entomologist, New Mexico State University Cooperative Extension Service.

Conditions in Brief

For the third consecutive year, bark beetle activity detected in the Region increased greatly, with conifer mortality reported on about three-quarter million acres compared with about 160,000 acres in 2001 and 73,000 acres in 2000. Most of this mortality (500,000+ acres) occurred in the ponderosa pine type, with the largest outbreaks in central and northern Arizona. Extensive piñon pine mortality caused by piñon Ips occurred in many parts of New Mexico and Arizona. These dramatic increases in beetle-caused pine mortality are primarily the result of continued drought throughout the Southwest. Based on ground observations conducted in the fall of 2002, many areas sustained heavy levels of additional mortality after the completion of aerial detection surveys.

Ponderosa pine mortality is reported as follows: western pine beetle (40,445 acres), mountain pine beetle (3,960 acres), roundheaded pine beetle (11,120 acres), and Ips engraver beetles (488,105 acres). The combined effects of western pine beetle and roundheaded pine beetle occurred on an additional 26,675 acres in New Mexico. In Arizona, many of the larger diameter ponderosa pines initially attacked by Ips species were also attacked by western pine beetle and/or roundheaded pine beetle. Piñon sustained heavy damage from piñon Ips at many locations, with mortality detected on about 148,370 acres. It should be noted that aerial surveys did not include much of the piñon-juniper woodlands across the Southwestern Region. Therefore, the total amount of piñon damage was severely underestimated. In the mixed conifer and spruce-fir cover types, trees were killed by spruce beetle (40,352 acres), fir engraver and western balsam bark beetle (13,725 acres), and Douglas-fir beetle (2,500 acres).

Western spruce budworm defoliation was detected on about 210,335 acres of mixed conifer forest in 2002, a decrease from approximately 472,100 acres the previous year. Aspen defoliation, caused by a variety of agents, was seen on about 59,490 acres in 2002 vs. 50,000 acres in 2001. Ponderosa pine needle miner activity increased slightly with 3,250 acres detected in 2002 compared to 2,700 acres in 2001. All of the needle miner activity was detected on state and private lands in New Mexico.

Dwarf mistletoes continue to be the most widespread and damaging forest pathogens in the Southwest. They cause an estimated annual volume loss of 25 million cubic feet. Over one-third of the ponderosa pine acreage and about one-half of the mixed conifer acreage has some level of infection. The incidence of dwarf mistletoes changes little from year to year, but is thought to have increased over the past century.

Root diseases continue to cause an estimated 5 million cubic foot volume loss annually, and create hazard trees in campgrounds and along roadways. Incidence is usually higher in mixed-conifer and spruce-fir forests than in ponderosa pine forests.

The incidence of white pine blister rust continues to increase in the Sacramento and adjoining White Mountains of southern New Mexico. Infected white pines have also been found on Gallinas Peak, Cibola National Forest, 50+ miles north of the main outbreak area.

Status of Insects

Bark Beetles

Western Pine Beetle

Dendroctonus brevicomis
Primary host: Ponderosa pine

Tree mortality attributed to western pine beetle increased to 40,445 acres in 2002 from 36,265 acres in 2001. Another 26,675 acres in New Mexico were recorded as being affected in combination with roundheaded pine beetle. One half of this acreage (13,338 acres) was added to the figure below and the other half added to the roundheaded pine beetle chart. In Arizona, no tree mortality was attributed directly to western pine beetle; however, this beetle was present in the lower boles of many trees initially infested by *Ips* beetles. In New Mexico, significant activity was detected on the Cibola (1,055 acres), Gila (31,515 acres), Lincoln (3,270) and Santa Fe (2,970) National Forests; Valles Caldera National Preserve (25 acres); Jemez Pueblo (770 acres), Mescalero Apache (660 acres) and Santa Clara Pueblo (30 acres) tribal lands; and 150 acres of State and private lands. Western pine beetle in combination with roundheaded pine beetle caused mortality on the Lincoln National Forest (23,635 acres); Mescalero Apache tribal lands (1,675 acres) and 1,365 acres of State and Private lands.

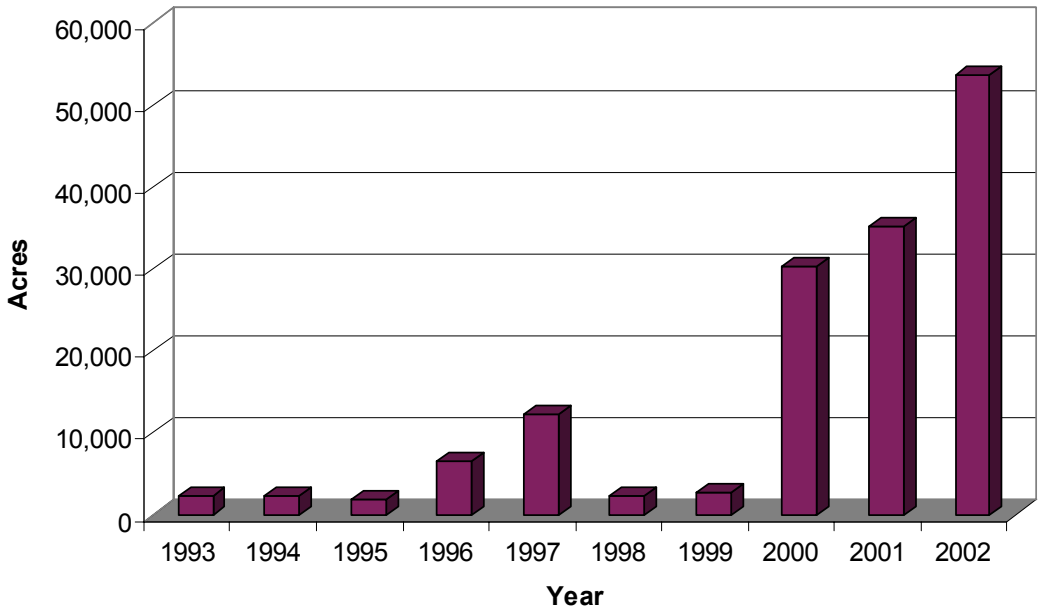

Figure 1. Western Pine Beetle Mortality in Arizona and New Mexico, 1993 - 2002.

Mountain Pine Beetle

Dendroctonus ponderosae
Primary hosts: Ponderosa, limber and bristlecone pine

Mountain pine beetle-caused mortality of ponderosa pine and limber pine increased from 2,270 acres in 2001 to 3,960 in 2002. In Arizona, mountain pine beetle-caused pine mortality occurred

on the Coconino (130 acres) and Kaibab (5 acres) National Forests and 60 acres on Grand Canyon National Park. Ground surveys found mountain pine beetle-infested bristlecone pine on the San Francisco Peaks, Coconino County. In New Mexico, trees killed by the mountain pine beetle were detected on the Carson (3,265 acres) and Santa Fe (230 acres) National Forests; Jicarilla Apache (5 acres), Picuris Pueblo (25 acres), Santa Clara Pueblo (30 acres) and Taos Pueblo (210 acres) tribal lands.

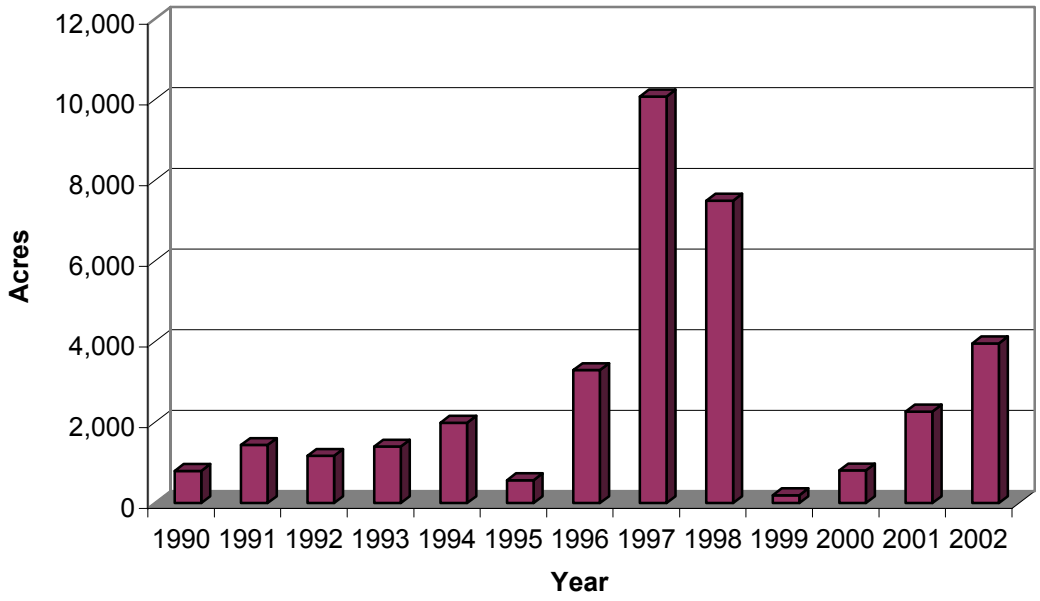

Figure 2. Mountain pine beetle mortality in Arizona and New Mexico, 1990 - 2002.

Roundheaded Pine Beetle

Dendroctonus adjunctus
Primary host: Ponderosa pine

Roundheaded pine beetle-caused tree mortality in the region increased more than three-fold from 3,670 acres in 2001 to 11,120 acres in 2002. In Arizona, roundheaded pine beetle mortality was recorded on 7,450 acres of the Coronado National Forest. In New Mexico, mortality was detected on the Lincoln (3,195 acres) National Forest and Mescalero Apache tribal lands (475 acres). Another 26,675 acres of ponderosa pine in New Mexico were recorded as being affected in combination with western pine beetle. One half of this acreage (13,338 acres) was added to the figure below and the other half to the western pine beetle figure.

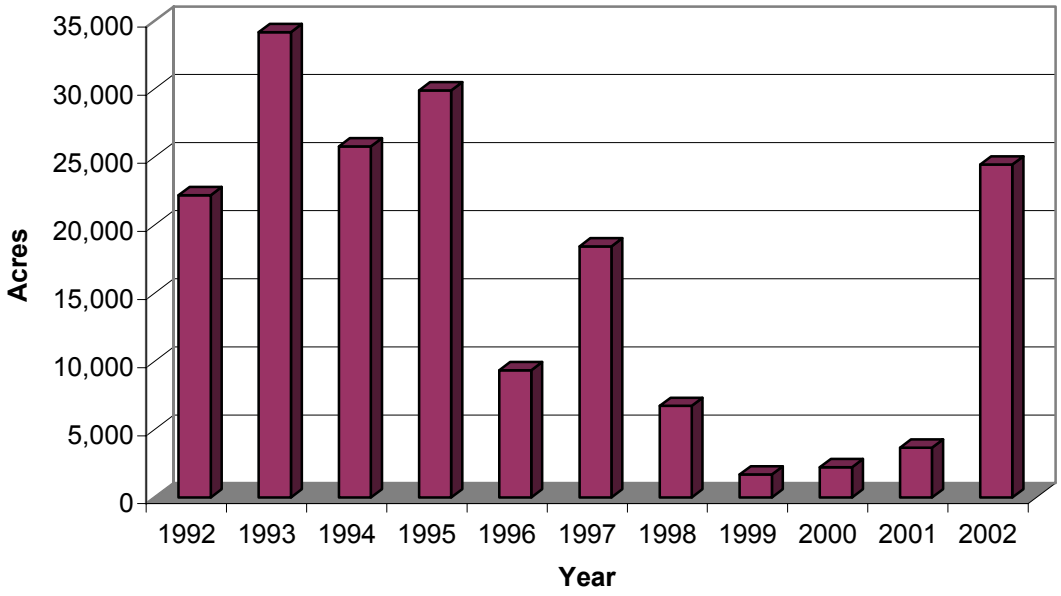

Figure 3. Ponderosa pine mortality from roundheaded pine beetle in Arizona and New Mexico, 1992 - 2002.

Ips Beetles

Ips spp.
Primary hosts: Ponderosa pine, piñon pine

Ponderosa pine mortality caused by *Ips* beetles increased roughly six-fold from 83,960 acres in 2001 to 488,105 acres in 2002. Several species of *Ips* were found attacking ponderosa pine in Arizona, including *I. lecontei*, *I. pini*, *I. calligraphus*, *I. latidens*, *I. knausi* and *I. integer*. Frequently, several *Ips* species were identified from a single infested tree and in combination with western pine beetle and other *Dendroctonus*. Ponderosa pine mortality caused by *Ips* species in Arizona was reported on the Apache-Sitgreaves (110,050 acres), Coconino (60,295 acres), Coronado (2,805 acres), Kaibab (6,010 acres), Prescott (35,955 acres) and Tonto (66,585 acres) National Forests; Saguaro (490 acres) and Walnut Canyon (1,385 acres) National Monuments; Grand Canyon National Park (5,690 acres); BLM lands (990 acres); Fort Apache (61,340 acres), Hualapai (195 acres), Navajo (6,545 acres) and San Carlos (111,220 acres) Indian Reservations and 9,755 acres of State and private lands. In New Mexico, mortality was detected on the Cibola (1,210 acres), Gila (325 acres), Lincoln (1,545 acres) and Santa Fe (825 acres) National Forests; Jicarilla Apache (75 acres) and Mescalero Apache (20 acres) tribal lands; and 4,795 acres of State and private lands

Piñon pine mortality caused by *Ips confusus* was detected on about 148,370 acres in 2002 compared to 17,150 acres in 2001; however, these figures underestimate regional mortality since not all the woodland type is covered during aerial surveys. Piñon ips-caused tree mortality was recorded on the Apache-Sitgreaves (170 acres), Coconino (33,970 acres), Coronado (280 acres), Kaibab (1,270 acres), and Prescott (40 acres) National Forests; Fort Apache (1,695 acres); Grand Canyon National Park (5,945 acres); Haulapai (785 acres) Navajo (17,700 acres), San Carlos

(4,195 acres), and Hopi (10,275 acres) Indian Reservations and 1,335 acres of State and private lands of Arizona. Piñon ips -caused tree mortality also occurred on the Carson (16,240 acres), Cibola (4,670 acres), Gila (1,440 acres) Lincoln (860 acres) and Santa Fe (5,425 acres) National Forests; Bandelier National Monument (2,405 acres); Cochiti Pueblo (15,705 acres), Jemez Pueblo (45 acres), and Santo Domingo Pueblo (2,735 acres) tribal lands; and 21,185 acres of State and private lands of New Mexico. Ground-truthing following a special aerial detection flight west of Cochiti Lake, NM revealed 67% of the piñon (about 4 million trees) over a 45,200-acre area had been killed by piñon ips.

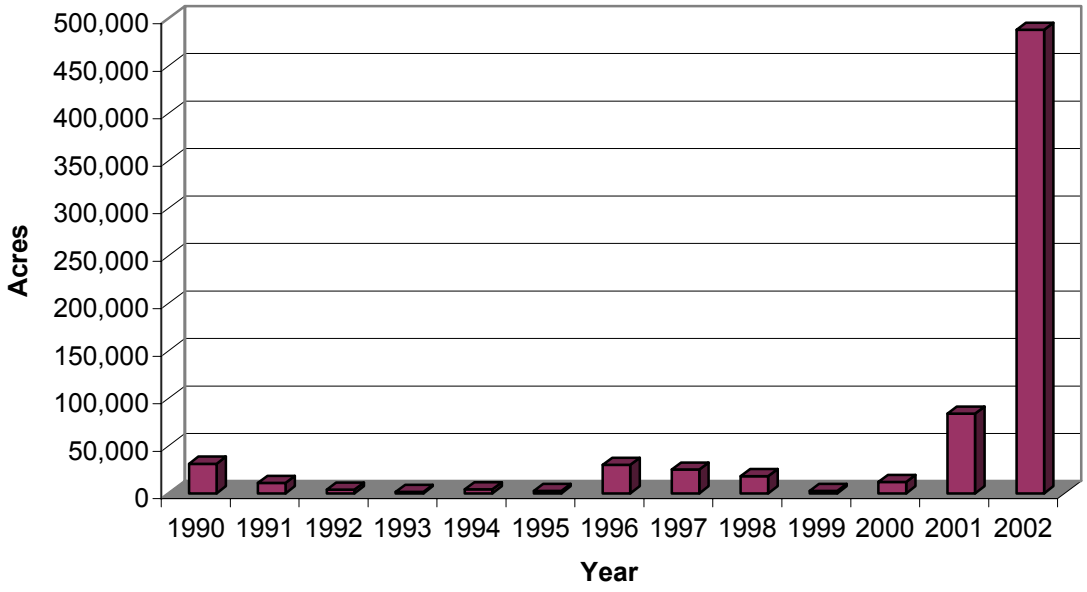

Figure 4. Ponderosa Pine Mortality from Ips Beetles in Arizona and New Mexico, 1990 - 2002.

Douglas-fir Beetle

Dendroctonus pseudotsugae
Host: Douglas-fir

Douglas-fir beetle mortality in the Southwest decreased from 3,125 acres in 2001 to 2,500 acres in 2002. In Arizona, Douglas-fir beetle mortality was recorded on the Apache-Sitgreaves (575 acres), Coconino (915 acres), Kaibab (565 acres) and Tonto (25 acres) National Forests; Fort Apache (10 acres) and San Carlos (35 acres) Indian Reservations; and 5 acres of State land. In New Mexico, Douglas-fir beetle-caused tree mortality was detected on the Carson (90 acres), Gila (40 acres), Lincoln (10 acres), and Santa Fe (175 acres) National Forests; Santa Clara Pueblo (10 acres) and Taos Pueblo (45 acres) tribal lands.

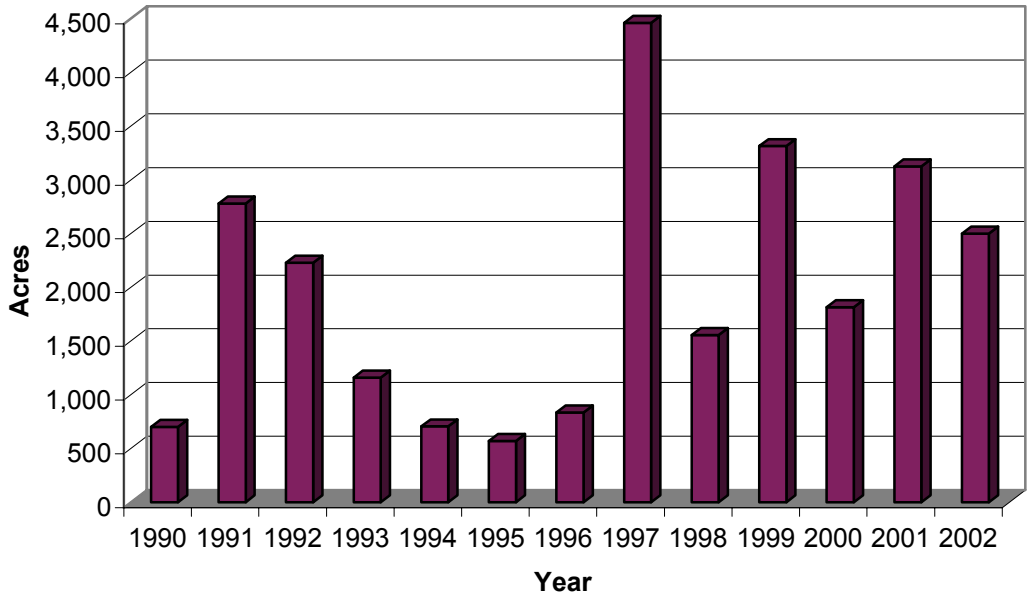

Figure 5. Douglas-fir Beetle Mortality in Arizona and New Mexico, 1990 – 2002.

Spruce Beetle

Dendroctonus rufipennis
Host: Spruce

Spruce beetle-caused tree mortality increased more than six fold from 6,215 acres in 2001 to 40,352 in 2002. In Arizona, spruce beetle mortality occurred on the Apache-Sitgreaves (15,680 acres) and Coronado (827 acres) National Forests; Fort Apache (15,585 acres) and Navajo (2,655 acres) Indian Reservations; and 200 acres of private lands. In New Mexico, spruce beetle related tree mortality occurred on the Carson (1,675 acres), Cibola (155 acres), Gila (15 acres), Lincoln (610 acres), and Santa Fe (2,440 acres) National Forests; the Valles Caldera National Preserve (20 acres) and 490 acres of Taos Pueblo tribal lands.

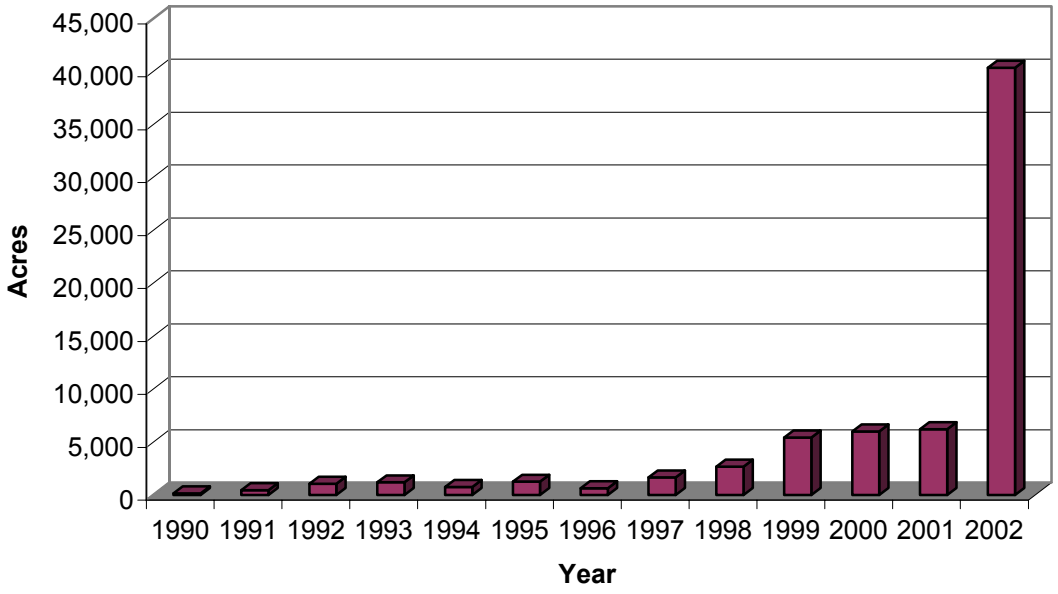

Figure 6. Mortality from Spruce Beetle in Arizona and New Mexico, 1990 – 2002.

True Fir Beetles

Fir Engraver Beetle, *Scolytus ventralis*
Western balsam bark beetle, *Dryocoetes confuses*
Hosts: White and subalpine/corkbark fir

Tree mortality in the Region increased in 2002 to 13,725 from 7,385 acres in 2001. In Arizona, fir mortality was recorded on the Apache-Sitgreaves (3,420 acres), Coconino (4,560 acres), Coronado (585), Kaibab (80 acres), and Tonto (85 acres) National Forests; Grand Canyon National Park (5 acres); Fort Apache (185 acres) and San Carlos (5 acres) Indian Reservations. In New Mexico, fir mortality was reported on the Carson (455 acres), Cibola (970 acres), Gila (410 acres), Lincoln (350 acres), and Santa Fe (1,655 acres) National Forests; Jicarilla Apache (160 acres), Mescalero Apache (20 acres), and Santa Clara Pueblo (320 acres) tribal lands; and 460 acres of State and private lands.

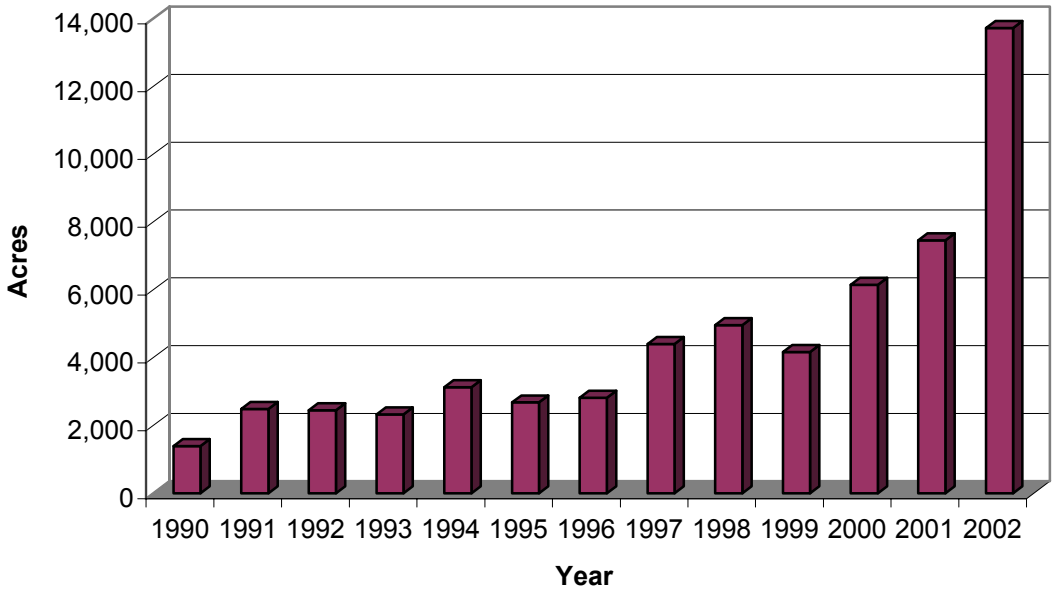

Figure 7. True Fir Mortality from Fir Engraver and Western Balsam Bark Beetles in Arizona and New Mexico from 1990 – 2002.

Mexican Pine Beetle and Southern Pine Beetle

Dendroctonus mexicanus, Dendroctonus frontalis
Hosts: Pines

Mexican pine beetle was found on the Chiricahua Mountains (Coronado National Forest and Chiricahua National Monument) in late 2000, the first record of its occurrence in the United States. Mortality of Apache and Chihuahua pine caused by a complex of Mexican pine beetle, southern pine beetle, and *Ips* species was detected on 485 acres in this area in 2001. In 2002, pine mortality within this area was labeled as being caused by *Ips* species only; however, funnel trap catches during 2002 indicate that *Dendroctonus* species are still present and active. See also "Activities" section in this report.

Defoliators

Western Spruce Budworm

Choristoneura occidentalis
Hosts: True firs, Douglas-fir, spruce

Western spruce budworm defoliation decreased Region-wide from 472,100 acres in 2001 to 210,335 in 2002. In Arizona, western spruce budworm defoliation was recorded on the Grand Canyon National Park (175 acres) and the Navajo Indian Reservation (11,255 acres). In New Mexico, western spruce budworm defoliation was detected on the Carson (114,680 acres), Cibola (1,695 acres), Gila (760 acres), Lincoln (130 acres), and Santa Fe (32,075 acres) National Forests; Valles Caldera National Preserve (440 acres); Jicarilla Apache (2,220 acres) and Taos Pueblo (8,265 acres) tribal lands; and 38,640 acres of State and private lands.

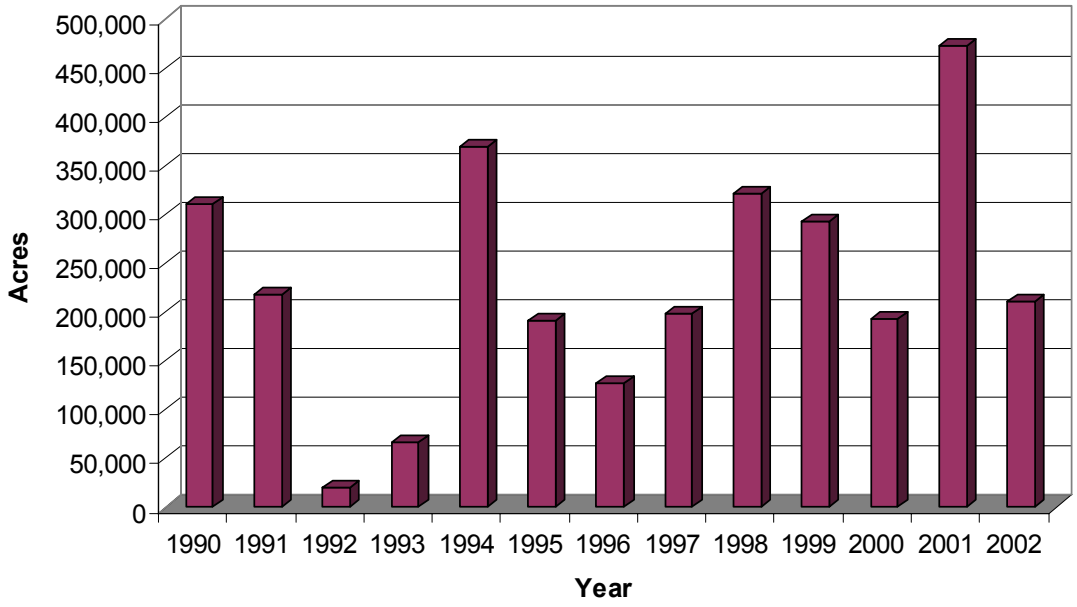

Figure 8. Western Spruce Budworm Activity in Arizona and New Mexico, 1990 – 2002.

Douglas-fir Tussock Moth

Orgyia pseudotsugata
Hosts: White fir, Douglas-fir, Spruce

Three known forest outbreaks of Douglas-fir tussock moth have caused substantial tree mortality in 2002. Two outbreaks are primarily on Forest Service lands in the Sacramento Mountains east and southeast of Cloudcroft. A third outbreak covers about 600 acres on the Bear Canyon Ranch east of Raton and straddles the Colorado border. This insect has also been an urban pest in northern New Mexico. It causes occasional defoliation of ornamental spruce, fir, and Douglas-fir in Cedar Crest, Raton, Glorietta, Pecos, and other foothill communities. No new defoliation caused by Douglas-fir tussock moth was detected in Arizona during 2002.

New Mexico Fir Looper

Galenara consimilus
Hosts: Douglas-fir and white fir

Defoliation caused by the New Mexico fir looper was detected on 3,865 acres on the Lincoln National Forest in 2002.

Nepytia janetae

Host: Spruce and true firs

No defoliation from this insect was detected in 2002. However, a new unidentified geometrid defoliator was observed in the White Mountains of Arizona in 2002. A total of 6,515 acres of defoliation were detected on the Apache-Sitgreaves NF and Fort Apache tribal lands.

Spruce Aphid

Elatobium abietinum
Host: Spruce

In Arizona, spruce aphid was seen during ground surveys but defoliation was not observed during the aerial detection flights. No spruce aphid activity was observed in New Mexico.

Ponderosa Pine Needle Miner

Coleotechnites ponderosae

No needle miner was detected in Arizona in 2002. In New Mexico, the chronic outbreak on State and private lands in the eastern foothills of the Sangre de Cristo Mountains increased slightly from over 2,700 acres in 2001 to around 3,250 acres in 2002. Thin canopies on drought stressed trees may have made the detection of this insect form the air less reliable. The insect is also common in the Los Alamos area and was easily detected from the ground, but not notable from the air.

Piñon Needle Scale

Matsucoccus acalyptus

Scale continues to affect piñon at several locations in the woodlands of Arizona and New Mexico. Damage to landscape piñon continues to be common statewide in New Mexico. Outbreaks covered thousands of acres on federal lands in the San Mateo and Datil mountains and in Lincoln County near the Capitan mountains and in smaller pockets south of Capitan. Other woodlands with reported damage include private lands south of Willard, east of El Rito, south of Corona, and east of Silver City. Woodlands near Silver City have suffered tremendous mortality due to a combination of this insect, drought, and bark beetles. Although not recorded during aerial detection surveys, moderate to heavy defoliation of piñon pine was observed from the ground on the Prescott, Coconino and Apache-Sitgreaves National Forests in Arizona.

Aspen Defoliation

Aspen Defoliator Complex:
Western Tent Caterpillar, *Malacosoma californicum*
Large Aspen Tortrix, *Choristoneura conflictana*
Black Leaf Spot, *Marssonina populi*
Weather-related Damage

Aspen defoliation, decline and mortality, caused by one or sometimes the entire above-named complex of insects, diseases, and abiotic factors stayed about the same: at 49,720 acres in 2001 and 59,490 in 2002. In Arizona, aspen has been in decline throughout the northern-half of the state, since a frost event occurred in June of 1999 that was followed by several years of drought. Although the acreage did not change this year, the degree of damage did. Many areas experienced large-scale mortality rather than mere defoliation. In Arizona, aspen decline was recorded on the Apache-Sitgreaves (12,145 acres), Coconino (5,220 acres), Coronado (55 acres),

Kaibab (16,370 acres), and Tonto (50 acres) National Forests; Grand Canyon National Park (4,220 acres); Fort Apache (3,155 acres) and Navajo (3,225 acres) Indian Reservations; and 395 acres of State and private lands. In New Mexico, defoliation was detected on the Carson (2,645 acres), Cibola (1,045 acres), Gila (625 acres), Lincoln (395 acres), and Santa Fe (3,530 acres) National Forests; Valles Caldera National Preserve (1,575 acres); Mescalero Apache (60 acres) and Santa Clara Pueblo (440 acres) tribal lands; and 4,340 acres of State and private holdings.

Figure 9. Aspen decline on the Coconino National Forest. Large scale mortality of aspen is occurring throughout northern Arizona since a June frost event in 1999, followed by several years of drought.

Miscellaneous Insects

American hornet moth (*Sesia tibialis*) damage continued on *Populus* and *Salix* species in the Flagstaff area.

Bagworms (*Thyriodopteryx* spp.) continue to be a problem in the Albuquerque area on junipers, cypress, and several hardwoods trees.

Bull pine sawfly *(Zadiprion townsendii)* populations continued to cause defoliation of ponderosa pine in several chronically infested areas around Santa Fe in 2002. These insects have also been reported from Las Vegas, Cedar Crest and Mountainair, New Mexico. The observed populations of this insect have been in the lower elevational distribution of ponderosa pine usually near the interface with piñon woodlands.

Elm leaf beetles (*Xanthogaleruca luteola*) continued at high levels throughout New Mexico on Siberian elms growing in urban and rural areas in 2002.

Fall webworm (*Hyphantria cunea)* continued to be common in New Mexico on landscape and lower riparian hardwoods, especially elms, mulberries, cottonwoods, and hybrid poplars. Activity also continued for the fourth consecutive year around Payson, Arizona.

Giant conifer aphids, (*Cinara* spp.) were observed on spruce and pines throughout Flagstaff and Coconino County during 2002.

Juniper and cypress bark beetle (*Phloeosinus* spp.) activity was observed throughout Arizona. Significant cypress bark beetle activity occurred in Yavapai County (Sedona, Cottonwood, Camp Verde, Dewey, Mayer, and Chino Valley). Mortality occurred in planted and native grown Arizona cypress and planted Leyland cypress. Native junipers also had cypress bark beetle activity, but it was unclear whether they colonized the trees before or after they died. Urban cypress in New Mexico were also reported to being attacked by cypress bark beetles.

Nantucket pine tip moth (*Rhyaciona frustrana*), western pine tip moth (*R. bushnelli*), and other *Rhyaciona* species continued to damage landscape pines, especially ponderosa pine, in New Mexico. Public service announcements regarding effective spray dates for the control of pine tip moth in the Albuquerque, Santa Fe, and Los Lunas areas were made with the cooperation of area Master Gardeners.

Oystershell scale (*Lepidosaphes ulmi*) continued to be common on aspen in the Flagstaff area.

Piñon needle miner (*Coleotechnites edulicola*) caused heavy defoliation on approximately 200 acres on the southeastern side of Santa Fe, New Mexico during the spring of 2002. Subsequent bark beetle infestation has resulted in high tree mortality in this area. The same area was defoliated in 2000. No other significant needle miner activity was detected.

Prescott scale *(Matsucoccus vexillorum)* caused significant defoliation of ponderosa pine on the San Carlos Indian Reservation in 2002.

Smaller European elm bark beetles (*Scolytus multistriatus*) continued to cause mortality in drought stressed Siberian elms in eastern New Mexico and to a lesser extent, statewide.

Spider mites (*Tetranychus urticae, Platytetranchus multidigituli, Oligonychus ununguis*) populations increased dramatically in ornamental juniper, spruce, honey locust, and other susceptible trees in early 2002.

Twig beetle (*Pityophthorus* spp., *Pityogenes* spp., *Pityotrichus* spp.) had extensive outbreaks on pine species in association with other bark beetles, especially *Ips* species, and throughout both Arizona and New Mexico in 2002. Although twig beetle damage was common across New

Mexico, the communities of Ruidoso, Quemado, Los Alamos, Santa Fe, Ojo Caliente and Pecos had particularly notable damage.

Status of Diseases

Mistletoes

Dwarf Mistletoes

Arceuthobium spp.
Hosts: Most conifers, especially pines and Douglas-fir

Dwarf mistletoes are the most widespread and damaging forest pathogens (disease-causing organisms) in the Southwest. There are eight species in the Region, each with a different primary tree host. Three species--those affecting ponderosa pine, piñon pine, and Douglas-fir--are found throughout most of the ranges of their hosts, while the other species have more limited distributions. Regionally, over one-third of the ponderosa pine type, and up to one-half the mixed conifer type, have some level of infection.

Dwarf mistletoes are considered to be pathogens of trees because of their damaging effects—growth reduction, distortion (i.e. witches' brooms), and decreased longevity. Essentially, they re-allocate growth to infected portions of the tree at the expense of the rest of the tree. Severe infection can kill trees directly or predispose them to other agents, especially bark beetles. Regionwide, dwarf mistletoes cause an estimated 25 million cubic foot loss in timber production annually. On the other hand, as a natural part of the forest dwarf mistletoes do have an ecological role and benefit some species.

On both the stand and landscape level, the distribution of dwarf mistletoes is usually patchy, with more or less discrete infection centers surrounded by areas without the disease. Infection centers expand very slowly, and overall incidence changes little from year to year. Thus, infestation is best described as a chronic situation rather than an outbreak or epidemic. However, because of fire suppression and selective cutting, the overall incidence of dwarf mistletoes has probably increased over the past century.

True Mistletoes

Phoradendron spp.
Hosts: Junipers; various hardwoods

Several species of true mistletoe occur in the Southwest. They are common in piñon-juniper woodlands throughout the region, and are locally abundant in lower riparian areas and desert shrublands. Heavy infection contributes toward host mortality, especially during periods of drought.

Root Diseases

Root diseases are associated with roughly one-third of the conifer mortality in the Region each year. They kill some trees outright and are often associated with bark beetle attack. They can also predispose trees to windthrow, an obvious concern in heavily-used areas. Root diseases are generally more common in mixed conifer and spruce-fir forests than in ponderosa pine forests. Like mistletoes, the incidence of root diseases changes little from year to year.

Armillaria Root Disease

Armillaria spp.
Hosts: Most conifers, aspen

Armillaria is the most common root disease in the Southwest, and may account for up to 80 percent of the root disease mortality in the Region. Recent surveys on the North Kaibab Ranger District found the fungus in about 30 percent of the standing live trees. In addition to causing disease, the fungus is a common decayer of dead woody material (a saprophyte).

Annosus Root Disease

Heterobasidion annosum
Hosts: Most conifers

Annosus root disease is probably the second most common root disease in the Southwest. It is found most often on true firs, although most conifers are susceptible. Like *Armillaria*, *Heterobasidion* is a common decayer of dead woody material as well a pathogen.

Other common root diseases…

in the Southwest include **Schweinitzii root/butt rot**, *Phaeolus schweinitzii*, often found on older Douglas-fir and occasionally ponderosa pine; **Tomentosus root/butt rot**, *Inonotus tomentosus,* on spruce; and **Ganoderma butt rot**, *Ganoderma applanatum*, found in many aspen stands. **Black Stain root disease**, *Leptographium wageneri,* appears to be rare in the Southwest.

Stem Decays

Stem decays are common in older trees throughout the Region. Decay represents an economic loss in terms of timber production, and can increase hazard on developed sites. On the other hand, decayed trees provide important habitat for some wildlife species, particularly cavity nesters. The most common stem decays in the Southwest include **red rot**, *Dichomitus squalens*, of ponderosa pine; **red ring rot**, *Phellinus pini,* affecting most conifers; **rust-red stringy rot**, *Echinodontium tinctorium*, on white fir; and **aspen trunk rot**, *Phellinus tremulae*.

Aspen Stem Cankers

The soft, living bark of aspen is highly susceptible to canker-causing fungi. One or more of these diseases are common in most aspen stands. The most common include **sooty bark canker**, *Encoelia pruinosa*; **black canker**, *Ceratocystis fimbriata*; **Cryptosphaeria canker**, *Cryptosphaeria populina*; and **Cytospora canker**, *Cytospora chrysosperma*. Cankers are one of the main reasons that aspen is a relatively short-lived tree.

Stem Rusts

White Pine Blister Rust

Cronartium ribicola
Host: Southwestern white pine

This very damaging, non-native disease occurs throughout most of the range of its host in the Sacramento and adjoining White Mountains of southern New Mexico. It appears to have arrived in this area by the early 1970's, but was not detected until 1990. Blister rust has since spread to the nearby Capitan Mountains, and to Gallinas Peak, located about 50 miles north of the Capitans. The disease has not yet been detected in northern New Mexico or in Arizona.

Within the outbreak area, moist mixed-conifer stands above 8000' typically have more blister rust than drier, lower elevation stands.

Broom Rusts

Melampsorella caryophyllacearum
Host: True firs

Chrysomyxa arctostaphyli
Host: Spruces

Broom rusts are found at low levels throughout much of the ranges of their hosts in the Southwest. High concentrations of fir broom rust occur in the Sandia Mountains of New Mexico and a few other locations. The disease is often quite noticeable, although damage is usually minimal. Occasionally, falling brooms or stem breakage at the point of infection present a hazard.

Limb Rust

Cronartium arizonicum
Host: Ponderosa pine

This disease is fairly common in portions of Arizona, and can be quite damaging to individual trees. The fungus causes progressive branch mortality, usually from the center of the crown. Waves of new infection typically occur at intervals of several years.

Comandra Blister Rust

Cronartium comandrae
Host: Pines

This disease has caused branch dieback and mortality on non-native Eldarica/Afghan pine in the Prescott, Payson, and Sedona areas. It occasionally infects ponderosa pines in this area, but has caused minimal damage.

Western Gall Rust

Peridermium (Endocronartium) harknessii
Host: Pines

This disease, more common in other parts of the West, is occasionally found on ponderosa pine in the Southwest. An unusual white-spored variety of the fungus was found in the Sandia Mountains in 2001. (Western gall rust, like other tree rusts, usually have orange or rust-colored spores.) **White-spored gall rust** is also known from the Chiricahua Mountains of Arizona.

Foliage Diseases

(see also Aspen Defoliation in Insect section)

Piñon needle rust (*Coleosporium* spp.) was detected in 2002 in woodlands near Santa Fe and White Rock, New Mexico.

Ponderosa Pine Needle Cast
Lophodermella cerina and other species

Needle cast of ponderosa pine was observed on 3,865 acres on the Lincoln National Forest in New Mexico. Discoloration and/or defoliation of ponderosa pine attributed to needle cast fungi was detected during aerial surveys on about 455 acres of Federal lands in 2001, vs. 2,175 acres in 2000. All of this activity occurred in New Mexico, with about 190 acres on the Santa Fe National Forest and 265 acres on Jicarilla Apache tribal lands. About 1,320 acres of private land in northern Colfax County were also affected.

Lophodermella appears to be the most common of several fungi that cause needle cast of ponderosa pine in the Southwest. Needle miner (an insect) and drought stress can produce symptoms very similar to those of needle cast. It can be difficult to determine the actual cause of discolored foliage during aerial surveys; assessments from the ground are often needed. The acreages reported here are usually based on limited ground checking and past experience.

Abiotic Damage

Drought

Discoloration of various shrubs and woody plants attributed to drought occurred on about 79,490 acres in 2002. In Arizona, this occurred on the Apache-Sitgreaves (1,940), Coconino (1,655 acres), Coronado (6,540), Kaibab (4,130), and Prescott (3,010 acres) National Forests, and on the Grand Canyon National Park (53,110 acres), Saguaro National Monument, (3,695 acres), and Navajo tribal lands (4,110 acres).

Table 1. Prominent 2002 Forest Insect and Disease Activity (acres) in Arizona and New Mexico.

Agent	State	National Forest	Tribal Lands	Other Federal	State & Private	Total
Western pine beetle	NM	38,840	1,460	0	150	40,450
WPB plus RHPB	NM	23,635	1,675	0	1,365	26,675
Mountain pine beetle	AZ	135	0	60	0	195
	NM	3,495	270	0	0	3,765
Roundheaded pine beetle	AZ	7,450	0	0	0	7,450
	NM	3,195	475	0	0	3,670
Ips beetle (ponderosa pine)	AZ	281,700	179,300	8,555	9,755	479,310
	NM	3,905	95	0	4,795	8,795
Ips beetle (piñon pine)	AZ	35,730	34,650	5,945	1,335	77,660
	NM	28,635	18,485	2,405	21,185	70,710
Douglas-fir beetle	AZ	2,080	45	0	5	2,130
	NM	315	55	0	0	370
Spruce beetle	AZ	16,915	18,240	0	200	35,355
	NM	4,895	490	20	0	5,405
True fir beetles	AZ	8,730	190	5	0	8,925
	NM	3,840	500	0	460	4,800
Western spruce budworm	AZ	0	11,255	175	0	11,430
	NM	149,340	10,485	440	38,640	198,905
Unknown geometrid	AZ	735	5,880	0	0	6,615
Ponderosa pine needle miner	NM	0	0	0	3,250	3,250
New Mexico fir looper	NM	3,865	0	0	0	3,685
Pine needlecast	NM	4,485	170	0	125	4,780
Aspen defoliation	AZ	33,840	6,380	4,220	395	44,835
	NM	8,240	500	1,575	4,340	14,655
Drought effects on shrubs	AZ	17,535	4,110	56,815	1,030	79,490
Root disease	AZ	219,000	**	**	**	219,000
	NM	860,000	**	**	**	860,000
Dwarf mistletoes	AZ	1,174,000	674,000	**	25,000	1,873,000
	NM	1,144,000	348,000	**	581,000	2,073,000

** Significant activity observed/known, but acreage not determined.

Table 2. Region 3 2002 Forest Insect and Disease Incidence by Site (in acres).

	Western Pine Beetle	WPB and RHPB	Mountain Pine Beetle	Round-headed Pine Beetle	Ponderosa Ips	Piñon Ips	Douglas-fir Beetle	Spruce Beetle	True Fir Beetles	Bark Beetle Totals
Apache-Sitgreaves NF					110,050	170	575	15,680	3,420	129,895
Coconino NF			130		60,295	33,970	915		4,560	99,870
Coronado NF				7,450	2,805	280	565	827	585	12,512
Kaibab NF			5		6,010	1,270			80	7,365
Prescott NF					35,955	40				35,995
Tonto NF					66,585		25		85	66,695
Grand Canyon NP			60		5,690	5,945			5	11,700
Saguaro NM					490					490
Walnut Canyon NM					1,385					1,385
BLM					990					990
Fort Apache Tribal					61,340	1,695	10	15,585	185	78,815
Hualapai Tribal					195	785				980
Navajo Tribal					6,545	17,700	35	2,655		26,935
San Carlos Tribal					111,220	4,195			5	115,420
Hopi Tribal						10,275				10,275
State & Private					9755	1335	5	200		11,295
2002 Arizona Total	**0**	**0**	**195**	**7,450**	**479,310**	**77,660**	**2,130**	**34,947**	**8,925**	**610,617**
Carson NF			3,265			16,240	90	1,675	455	21,725
Cibola NF	1,055				1,210	4,670		155	970	8,060
Gila NF	31,515				325	1,440	40	15	410	33,745
Lincoln NF	3,270	23,635		3,195	1,545	860	10	610	350	33,475
Santa Fe NF	2,970		230		825	5,425	175	2,440	1,655	13,720
Bandelier NM						2,405				2,405
Valles Caldera NP	25							20		45
Cochiti Pueblo						15,705				15,705
Isleta Pueblo										0
Jemez Pueblo	770					45				815
Jicarilla Apache Tribal			5		75				160	240
Mescalero Apache	660	1,675		475	20				20	2,850
Picuris Pueblo			25							25
Santa Clara Pueblo	30		30				10		320	390
Santo Domingo Pueblo						2,735				2,735
Taos Pueblo			210				45	490		745
State & Private	150	1,365			4,795	21,185			460	27,955
New Mexico total	**40,445**	**26,675**	**3,765**	**3,670**	**8,795**	**70,710**	**370**	**5,405**	**4,800**	**164,635**
SW Region total	**40,445**	**26,675**	**3,960**	**11,120**	**488,105**	**148,370**	**2,500**	**40,352**	**13,725**	**775,252**

Table 2. Region 3 2002 Forest Insect and Disease Incidence by Site (in acres) (continued).

	Western Spruce Budworm	Unknown Geometrid	Aspen Damage	NM Fir Looper	Needle Cast	Drought	Defoliation Total
Apache-Sitgreaves NF		735	12,145			1,940	14,820
Coconino NF			5,220			1,655	6,875
Coronado NF			55			6,540	6,595
Kaibab NF			16,370			4,130	20,500
Prescott NF						3,010	3,010
Tonto NF			50			260	310
Grand Canyon NP	175		4,220			53,110	57,505
Saguaro NM						3,695	3,695
Walnut Canyon NM							0
BLM						10	10
Fort Apache Tribal		5,880	3,155				9,035
Hualapai Tribal							0
Navajo Tribal	11,255		3,225			4,110	18,590
San Carlos Tribal							0
Hopi Tribal							0
State & Private			395			1,030	1,425
2002 Arizona Total	**11,430**	**6,615**	**44,835**	**0**	**0**	**79,490**	**142,370**
Carson NF	114,680		2,645		1,490		118,815
Cibola NF	1,695		1,045		580		3,320
Gila NF	760		625		315		1,700
Lincoln NF	130		395	3,865			4,390
Santa Fe NF	32,075		3,530		2,100		37,705
Bandelier NM							0
Valles Caldera NP	440		1,575				2,015
Cochiti Pueblo							0
Isleta Pueblo					170		170
Jemez Pueblo							0
Jicarilla Apache Tribal	2,220						2,220
Mescalero Apache			60				60
Picuris Pueblo							0
Santa Clara Pueblo			440				440
Santo Domingo Pueblo							0
Taos Pueblo	8,265						8,265
State & Private	38,640		4,340		125		43,105
New Mexico Total	**198,905**	**0**	**14,655**	**3,865**	**4,780**	**0**	**222,205**
SW Region Total	**210,335**	**6,615**	**59,490**	**3,865**	**4,780**	**79,490**	**364,575**

Biological Evaluations and Technical Assistance

Our staff is "on call" to provide information on forest insect and disease activity, including input for resource planning and management activities. We provide this information to the Forest Service and other land management agencies. The following letters/reports document much of this work done in 2002:

Arizona Zone

1. Bark beetle activity in the Horsethief Basin Recreation Area, Bradshaw RD. 03/02.

2. Bark beetle activity associated with thinning and chipping near Blue Ridge RD, Mogollon RD, Coconino NF. 06/02.

3. Forest health management on the Bullock Fire, Santa Catalina RD, Coronado NF. 07/02.

4. Bark beetle activity on the Alpine RD, Apache-Sitgreaves NFs. 09-02.

5. Bark beetle activity in recreation sites on the Bradshaw RD, Prescott NF. 10/02.

6. Bark beetle activity in recreation sites on the Black Mesa RD, Lakeside RD, Apache-Sitgreaves NFs. 10/02.

7. Douglas-fir beetle activity in Rodeo-Chediski Fire, Black Mesa RD, Apache-Sitgreaves NFs. 10/02.

8. Prescott Scale Suppression Project for FY 2003, Phoenix Area Office, USDI-Bureau of Indian Affairs. 10/02.

9. Pretreatment biological evaluation for the Corduroy Dwarf-Mistletoe Management Project, Phoenix Area Office, USDI-Bureau of Indian Affairs. 10/02.

10. Spruce beetle activity, Pinaleño Mts., Safford RD, Coronado NF. 10/02.

11. Spruce beetle at Snowbowl Ski Area, Peaks RD, Coconino NF. 10/02.

12. Bark beetle activity in Pine Flats Campground, Red Rock RD, Coconino NF. 11/02.

New Mexico Zone

1. Evaluation of ponderosa pine mortality occurring on the Silver City and Reserve Ranger Districts, Gila National Forest. 4/02.

2. White pine blister rust on Gallinas Peak, Mountainair Ranger District, Cibola National Forest. 6/02.

3. Recent ponderosa pine mortality along Forest Road 10, Jemez Ranger District, Santa Fe National Forest. 8/02.

4. Evaluation of proposed FY 2003 Fence Line South dwarf mistletoe control/thinning project and recently completed portions of FY 2002 Cabin Finger project, Jicarilla Apache Indian Reservation. 8/02.

5. Evaluation of proposed FY 2003 forest health projects, Mescalero Apache Indian Reservation. 9/02.

6. Examination of recent thinning areas and recommendations for management of bark beetles on Los Alamos National Laboratory forested lands. 9/02.

7. Evaluation of proposed FY 2003 Cebollita Peak project, Acoma Pueblo, and Blue Water Canyon project, Isleta Pueblo. 9/02.

8. Bark beetle activity at four sites on the Tres Piedras Ranger District, Carson National Forest. 10/02.

9. Bark beetle activity at Paliza Group Campground, Jemez Ranger District, Santa Fe National Forest. 10/02.

10. Bark beetle activity at Little Walnut Picnic Ground and Gomez Group Picnic area, Silver City Ranger District, Gila National Forest. 10/02.

11. Evaluation of proposed Felipito II dwarf mistletoe control/thinning project, El Rito Ranger District, Carson National Forest. 10/02.

12. Evaluation of proposed Camp May Road dwarf mistletoe control/thinning project, Espanola Ranger District, Santa Fe National Forest. 10/02.

13. Evaluation of proposed White Mule dwarf mistletoe control/thinning project, Guadalupe Ranger District, Lincoln National Forest. 11/02.

14. Evaluation of proposed bark beetle management activities in the Paliza Family, San Antonio, Redondo, and Jemez Falls Campgrounds, Jemez Ranger District, Santa Fe National Forest. 11/02.

15. Recent ponderosa pine and Douglas-fir mortality in Guadalupe Mountains National Park, Texas. 12/02.

16. Survey of piñon pine mortality in and around the town of Cochiti Lake and on Cochiti Pueblo. 12/02.

Publications

Conklin, D.A. 2002. Emergence of latent dwarf mistletoe infection in young ponderosa pine regeneration: 10-year monitoring of the Whitetail A&B project at Mescalero. USDA Forest Service, Southwestern Region, R3-02-02. 8 p.

Coyle, D. R., J. D. McMillin, R. B. Hall & E. R. Hart. 2002. Impact of cottonwood leaf beetle (Coleoptera: Chrysomelidae) defoliation on *Populus* growth and biomass accumulation. *Agricultural and Forest Entomology* 4: 293 – 300.

Other Entomology and Pathology Activities in 2002

Insect and Disease Management Workshops

We periodically offer 2-3 day workshops on forest insect and disease identification, biology and management. These sessions are attended by Forest Service, Bureau of Indian Affairs, and National Park Service personnel; as well as by Tribal resource managers and employees from other Federal and State agencies. In the spring, we usually offer a workshop for recreation managers and their staffs that emphasizes hazard tree management. In the fall, we usually offer a workshop that covers the entire forest ecosystem. We also offer more informal training on request, particularly for field crews.

Aerial Detection Survey (ADS) Highlights 2002

Due to increased tree mortality in both the ponderosa and pinyon/juniper types in 2002, several special surveys were requested of land ownerships not usually part of the annual aerial detection survey. Normally the pinyon/juniper woodlands are excluded from the annual survey because of limited funding, time constraints for this extensive area, and the limited wood product utilization of the type. In New Mexico, a special survey was done on the Cochiti Pueblo where there was considerable tree mortality due to a piñon ips infestation. Ground plots showed a 67 percent of the piñon, or about 4 million trees, had been killed by the piñon ips bark beetle over this 45,200-acre area. In Arizona, portions of the Grand Canyon National Park and Coronado National Forest not normally flown due to high volumes of aviation traffic, and the Hopi Reservation were included as special flights. One area on the Apache-Sitgreaves National Forest, which had been flown in the early part of the season, was reflown in October to record any increase in mortality. The impacted acreage increased by 300 percent and the number of trees killed increased by 600% over the data gathered in the earlier flight. Aerial Detection Survey training was provided to the new State Cooperator in Arizona. A reflight of private lands in the communities of Pine and Strawberry near Payson was flown by the State Cooperator to evaluate the increased mortality impacting homeowners.

The Digital Aerial Sketchmapping System was used by the State Cooperator as a training tool. This system is computerized, maps are loaded onto the computer and the location of the aircraft is kept current on the maps by means of a global positioning system monitor. Insect and disease damage data are input via a touch screen. The surveyor is able to track their location even in areas with few landmarks. It is anticipated to be a major addition to the ADS program in Arizona in 2003. Both State and federal surveyors are planning to use the system during flights over ponderosa pine forests and whatever pinyon woodlands are flown.

Contact Bobbe Fitzgibbon for additional information.

Southern Pine Beetle/Mexican Pine Beetle Monitoring in the Chiricahua Mountains of Southern AZ

In 2000, 11,705 acres of tree mortality caused by southern pine beetle, *Dendroctonus frontalis*, was recorded in the Chiricahua Mountains of Southern Arizona. By December of 2000, a few Mexican pine beetles, *Dendroctonus mexicanus* were found in infested trees along with southern pine beetle. A line of four Lindgren funnel traps, two baited with frontalin lure and two baited with a 3 component experimental lure for western pine beetle, was established in Pinery Canyon in April of 2001 to monitor the populations. Traps were moved to Turkey Creek Canyon in February of 2002 due to a shift in the insect population. Trap contents are checked weekly to determine what beetles are actively flying at that time. Insects from the funnel traps and from the

destructively sampled trees are sent to the Southern Research Station with an occasional sub sample sent to Dartmouth College. Beetles are checked for phoretic mites and mites are checked for mycangial fungi. Both trapping and sampling indicated that the population of southern pine beetles has decreased while the population of Mexican Pine Beetle has increased. Trapping is scheduled to end in May of 2003. The phoretic mites infesting both species are being studied at the Southern Research Station by John Moser and Kier Klepzig. The mycangial fungi are being studied at Dartmouth by Richard Hoffstettler. Additional field work is being proposed by Richard Hoffstetler and Dr. Matthew Ayers, however, that work will be dependent on the outcome of pending funding requests.

Contact Bobbe Fitzgibbon for additional information.

Spruce Aphid/*Nepytia janetae* impact plots on Mt. Graham, in the White Mountains and other locations with host type within Arizona

The exotic spruce aphid, *Elatobium abietinum,* caused spruce mortality at varying levels on 46,548 acres in Arizona in both spruce-fir and mixed conifer stands. This insect was active on Mt. Graham in the Pinaleño Mountains in 2002. The looper, *Nepytia janetae*, had previously defoliated high elevation spruce and fir trees in the Pinaleño and White Mountains of Arizona. In 2001, several pockets of tree mortality in the White Mountains, totaling 1,472 acres, occurred in stands defoliated during the winters of 97-98 and 98-99 by *Nepytia janetae.* Impact plots have been established for both defoliators. Plots are monitored annually for current defoliation, tree mortality, bark beetle activity, and impact to regeneration size classes. Temperature is monitored in several areas to determine insect population trends associated with local weather conditions. Data collected is being used to determine the impact of these two defoliators, key factors that trigger outbreaks and the biology of the insects in the Southwest.

This is a cooperative venture between Forest Health and Ann Lynch of the Rocky Mountain Research Station.

Contact Bobbe Fitzgibbon for additional information.

The Mount Graham Red Squirrel Recovery Team, Technical Subgroup Participation

The recovery team is an Interdisciplinary Team charged with revising the Recovery Plan for the Mount Graham Red Squirrel (MGRS), an endangered species confined to a sky island in southeastern Arizona. The Technical Subgroup consists of technical experts on the squirrel, fire ecology, entomology, etc., who provide input into creation of a revised Recovery Plan. Since the writing of the first plan, which contained very little information about potential threats from native insects and diseases, outbreaks of defoliating insects and bark beetles have caused extensive tree mortality in MGRS habitat. One of these insects, spruce aphid, is introduced. The squirrels feed on the cones produced by mature overstory trees, trees that have had been greatly reduced. Issue papers are being written for the plan. The Technical Subgroup report will go to the Implementation Team who will decide how to use the recommendations of the Technical Subgroup to develop an environmentally and economically sound Recovery Plan.

Contac Bobbe Fitzgibbon or Mary Lou Fairweather for additional information.

The Role of Wildland Fire and Subsequent Insect Attack on Ponderosa Pine Mortality

This project will define the impact caused by insects when interacting with another disturbance agent, wildfire. This will allow us to more accurately assist land managers in predicting potential tree mortality in post-fire situations. Currently, there is a lack of detailed information regarding fire/insect impact in ponderosa pine ecosystems. For example, written and visual guidelines are largely lacking for field personnel to determine what tree will live or die in the near future in relation to the amount of damage caused by fire or the probability of injured trees being killed by insects. Furthermore, the probability of fire-damaged trees providing the source of an insect outbreak that subsequently spreads to uninjured trees has not been rigorously examined. This project will address the lack of adequate information by formulating models and creating visual guides and, therefore, permit land managers to make more informed decisions regarding salvaging and insect control. This information will also be useful in the development of prescriptions for prescribed burning. This 3-year, multi-regional (Regions 1,2 and 3) study is examining fires that occurred in 2000. In 2001 we established plots in 4 National Forests: Black Hills in South Dakota, Custer in Montana, Arapaho-Roosevelt in Colorado and Kaibab/Coconino in Arizona. In each area, we sampled 1500+ trees in burned areas and 500 trees in unburned areas. For each tree, we measured height, dbh, pre-fire live crown ratio, percent crown scorch, percent crown consumption, percent scorched basal circumference, scorch height on the bole, and insect presence. In addition, we collected 4 phloem samples from each of 200+ additional trees in each area to quantify the relationship between exterior signs of fire-caused damage and cambium damage. In 2002 all burn and unburned plots were re-measured across all sites. Tree mortality will be monitored for 3 years post burn. Our goal is to provide land managers with quantitatively based guidelines for assessing potential tree mortality following wildland burns.

Contact Joel McMillin for additional information.

Effects of prescribed fire on dwarf mistletoe

We are continuing to monitor the effects of prescribed fire (underburns) on dwarf mistletoe infection in ponderosa pine. In 2002, we remeasured plots in five areas that were burned between 1997 and 1999 on the Santa Fe and Cibola National Forests. Study areas include San Juan Mesa and Stable Mesa in the Jemez Mountains, the Manzano Mountains, and Mt. Taylor. Our latest results confirm the strong tendency of underburning to reduce infection levels, although significant amounts of crown scorch are probably needed to have a reducing effect. In addition to testing the use of fire as a management tool for dwarf mistletoe, this effort is increasing our understanding of the survival of scorched trees and bark beetle activity in areas burned at low to moderate intensity.

Contact Dave Conklin for additional information.

White pine blister rust monitoring in New Mexico

Since its discovery on the Lincoln National Forest near Cloudcroft in 1990, we have been monitoring the spread and effects of this non-native disease using a small set of permanent plots. In 2002, remeasurements were conducted on three of our oldest plots (established 1990/91): two on the Sacramento Ranger District, and one on the Mescalero Apache Indian Reservation. Two new plots were also established in 2002: one on the dry, southern end of the Sacramento District, and the other on Gallinas Peak (Mountainair Ranger District, Cibola National Forest), where the disease was first detected in 1999. A total of 14 of these “rust behavior plots,” each containing

40-50 southwestern white, have now been established in the outbreak areas. Additional monitoring has included annual "scouting" for the disease in other parts of the Southwest.

Contact Dave Conklin for additional information.

Visit Us Online

In an effort to better serve the Internet user, we continue to expand our on-line information base. The Forest Service Southwestern Region hosts the Forestry & Forest Health website at http://www.fs.fed.us/r3/resources/health/index.shtml. Technical information posted on these sites includes annual Forest Insect and Disease Conditions reports, literature on pest biology and management, and general information on the forest types of the Southwest. Administrative information includes roles, activities, and organizational staffing. The Arizona Zone Office maintains a website hosted by the Northern Arizona University School of Ecosystem Science and Management at http://www.for.nau.edu/usfs/r3_fpm. Additionally, our Forest Health Protection national office maintains a website at http://www.fs.fed.us/foresthealth/ which includes program overviews as well as excellent publications links.

Appendix

Instructions for Submitting Insect and Disease Specimens for Identification

Both Zone offices are equipped to receive forest insect or disease specimens submitted from the field for identification. Specimens may be shipped to the appropriate Zone Office as listed on the title page of this report. The following procedures for collecting and shipping specimens should be used:

Collecting:

1. Adequate material should be collected

2. Adequate information should be recorded, including:

    a. location of collection
    b. when collected
    c. who collected the specimen
    d. host description (species, age, condition, etc.)
    e. area description (forest type, site conditions, etc.)
    f. unusual conditions (frost, poor drainage, etc.)

3. Personal opinion of the cause of the problem may be helpful.

Packing:

1. **Larvae and other soft-bodied insects** should be shipped in small screw-top vials or bottles containing at least 70% isopropyl (rubbing) alcohol. Make sure bottles are well sealed.

2. **Pupae and hard-bodied insects** may be shipped either in alcohol or in small boxes. Specimens should be placed between layers of tissue paper in the boxes. Pack carefully and make sure there is little movement of material within the box. Do not pack insects in cotton.

3. **Needle or foliage diseases**: Do not ship in plastic bags as condensation can become a problem. Use a paper bag or wrap in newspaper. Pack carefully and make sure there is little movement within the box.

4. **Mushrooms and conks**: Do not ship in plastic bags. Either pack and ship immediately or air-dry and pack. To pack, wrap specimens in newspaper and pack into a shipping box with more newspaper. If on wood, include some the decayed wood.